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Declaration

I, Michihiko Matsuba, President of Fukuyama Sangyo Honyaku Center, Ltd., of 16-3, 2-chome, Nogami-cho, Fukuyama, Japan, do solemnly and sincerely declare that I understand well both the Japanese and English languages and that the attached document in English is a full and faithful translation, of the copy of Japanese Unexamined Patent No. Hei-8-95145 laid open on April 12, 1996.

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INTERCHANGEABLE LENS MOUNT PART CONNECTION MECHANISM IN MOTOR-DRIVEN DIAPHRAGM DRIVE MECHANISM AND AUTOFOCUS DRIVE MECHANISM OF CAMERA

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SPECIFICATION

[TITLE OF THE INVENTION] INTERCHANGEABLE LENS MOUNT PART CONNECTION MECHANISM IN MOTOR-DRIVEN DIAPHRAGM DRIVE MECHANISM AND AUTOFOCUS DRIVE MECHANISM OF CAMERA

[ABSTRACT]

[Object] To provide a diaphragm drive mechanism and a focus drive mechanism of an interchangeable lens camera connected to each other by two pairs of couplers at lens mount parts, to prevent erroneous connection between the two pairs of couplers, prevent an increase in size of the lens mount parts,

make the couplers common, and prevent entanglement of both couplers.

[Construction] A pair of diaphragm couplers 23 and 30 and a pair of focus couplers 22 and 33 are disposed at positions with a center angle greater than 90 degrees when the optical axis of an image-taking optical system of the camera is defined as a center. Furthermore, a diaphragm coupler at the lens body 20 side and a focus coupler at the lens body side are shaft-borne by a mount plate and a fixed barrel that are different fixed members, respectively.

[WHAT IS CLAIMED IS:]

[Claim 1] A connection mechanism of interchangeable lens mount parts in a motor driven diaphragm drive mechanism and an autofocus drive mechanism of a camera, comprising:

a first pair of couplers (23 and 30) which are disposed at interchangeable lens mount parts (11 and 21) so as to connect the motor-driven diaphragm drive mechanism between a camera body (10) and a lens body (20),

a second pair of couplers (22 and 33) disposed at the interchangeable lens mount parts (11 and 21) so as to connect the autofocus drive mechanism between the camera body (10) and the lens body (20), wherein

the first pair of couplers (23 and 30) and the second pair of

couplers (22 and 23) are disposed at positions with a center angle greater than 90 degrees when the optical axis of an image-taking optical system of the camera is defined as the center,

the first pair of couplers comprise a first camera body side coupler (30) and a first lens body side coupler (23),

the second pair of couplers comprise a second camera body side coupler (33) and a second lens body side coupler (22), and

the first lens body side coupler (23) and the second lens body side coupler (22) are shaft-borne by different fixed members, respectively.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention] The present invention relates to a connection mechanism of interchangeable lens mount parts in a motor driven diaphragm drive mechanism and an autofocus drive mechanism of a camera.

[0002]

[Prior Art and Problem to be Solved by the Invention] In the case of an interchangeable lens camera, when a stopping-down operation of the lens side is carried out by using a motor mounted inside the interchangeable lens, the motor becomes necessary for individual interchangeable lenses, this

increases the cost of the entire system and makes it difficult to downsize the interchangeable lenses.

[0003] Furthermore, when the diaphragm in the lens is driven by a motor at the camera body side via a coupler that is engageable with and disengageable from the lens mount part, this is advantageous for reduction in system cost (in particular, lens cost) of the entire camera, and has a structural advantage in that the stopping-down stroke can be changed. However, since the coupler transmission system is conventionally used for focus driving, if the coupler transmission system is also used for diaphragm driving, two couplers are provided at the mount part. In such a case, conventionally, for structural reasons in the connection system of the drive mechanism between the camera body side and the lens body side, coupler setting positions have both advantages and disadvantages.

[0004] Particularly, in a bayonet mount system, to mount the lens body, when the lens body is rotated, it is necessary that diaphragm couplers and focus couplers are securely connected between the camera body side and the lens body side while corresponding to each other, respectively. Thus, erroneous connection must be avoided when two or more pairs of couplers are provided at the mount parts. Therefore, for example, the

coupler shape is made different among the pairs, or the diameter of the coupler set position from the rotation center of the lens body is made different among the pairs.

[0005] However, in the abovementioned methods, the couplers cannot be made common or downsizing of the camera is obstructed by an increase in width of the mount plates.

[0006] Furthermore, when two couplers for transmitting rotational movement are shaft-borne by the same member at the mount parts, if slight divergence exists in the positional relationship between the two bearings, entanglement (unbalanced load on the bearings when rotating) occurs between the two couplers, and this may result in nonsmooth operation.

[0007] In view of the conventional technical problems mentioned above, the present invention has been made in order to effectively solve these. Therefore, an object of the invention is to provide a connection mechanism provided with couplers for a motor-driven diaphragm drive mechanism and couplers for an autofocus drive mechanism at mount parts, which makes the connection between these couplers secure, contributes to realization of common couplers and downsizing of cameras, and realizes smooth operations of the couplers without entanglement between the couplers although two pairs of couplers are provided.

[0008]

[Means for Solving the Problem] A connection mechanism relating to the invention solves the abovementioned conventional technical problems and has the following construction to achieve the object. Namely, in a connection mechanism for interchangeable lens mount parts in a motor-driven diaphragm drive mechanism and an autofocus drive mechanism of a camera, a first pair of couplers disposed at interchangeable lens mount parts to connect the motor-driven diaphragm drive mechanism between the camera body and the lens body and a second pair of couplers disposed at interchangeable lens mount parts to connect the autofocus drive mechanism between the camera body and the lens body are provided, the first pair of couplers and the second pair of couplers are disposed at positions with a center angle greater than 90 degrees when the optical axis of the image-taking optical system of this camera is defined as the center, the first pair of couplers comprises a first camera body side coupler and a first lens body side coupler, the second pair of couplers comprise a second camera body side coupler and a second lens body side coupler, and the first lens body side coupler and the second lens body side coupler are shaft-borne by different fixed members, respectively.

[0009]

[Action and Effect of the Invention] In the connection mechanism relating to the invention, since the first pair of couplers (diaphragm couplers) can be disposed so as to have the same radius distance from the optical axis as those of the second pair of couplers (focus couplers), it is not necessary to increase the widths of the mount parts. Furthermore, since the center angle between the couplers is set to be greater than 90 degrees, the center angle is greater than the lens body maximum rotation angle in a case where the number of mount claws is minimum (two), and when the lens body is mounted or detached, there is no instance where one coupler passes over the other coupler, whereby erroneous connection does not occur.

[0010] Furthermore, since the two couplers at the lens body side are shaft-borne by different fixed members as in the case of, for example, the mount plate and a fixed barrel, operations of the couplers are smooth without entanglement.

[0011]

[Embodiment] Hereinafter, an embodiment of a connection mechanism of interchangeable lens mount parts relating to the invention is described with reference to Fig. 1 through Fig. 7.

[0012] Fig. 1 is a front view showing in perspective the main part mechanism of the camera body side having the connection

mechanism of this embodiment. The camera body 10 has, on its front surface, a camera mount plate 11 on which a lens body 20 (see Figs. 2, 3, and 4) is detachably mounted by a bayonet system. The mount plate 11 is formed into a disk annular plate around the optical axis of the image-taking optical system. In the bayonet mount, the lens body rotation angle when mounting or detaching the lens in a case of mount claws provided is (360/2n) degrees. The minimum number of mount claws are two, and therefore, the maximum rotation angle of the lens body 20 when the lens is mounted or detached becomes 90 degrees. In the figures, a focal plane shutter 12 is disposed immediately in front of a film image frame (not shown) and covers this frame, and in front of the shutter, a main mirror 14 and a mirror frame 13 thereof are shown, and these are arranged on the optical axis of the image-taking optical system.

[0013] Inside the mount plate 11, as an engageable and disengageable connection mechanism for transmitting a driving force for driving operations of diaphragm blades 28 (see Fig. 3) and a focusing lens 38 (see Fig. 4) inside the lens body 20, two couplers 30 and 33 are provided. One is a diaphragm coupler 30, and the other is a focus coupler 33. Inside this mount plate 11, as an engageable and disengageable mechanism other than the two couplers 30 and 33, a lock pin 17 for

preventing the lens body 20 mounted on the camera body 10 from moving or coming off is also provided. The couplers 30 and 33 and the lock pin 17 are pressed by springs in a direction to project from the joint surface of the mount plate 11, and are structured so as to withdraw to positions at the rear of the joint surface of the mount plate 11 to allow the rotation of the lens body 20 around the optical axis when mounting and detaching the lens body 20.

[0014] The diaphragm coupler 30 and the focus coupler 33 are disposed at positions point-symmetric about the optical axis of the abovementioned image-taking optical system. For the respective couplers 30 and 33, the motor drive mechanisms 15 and 16 are provided so as to be adjacent to the couplers 30 and 33 and be positioned outside the optical path of the image-taking optical system.

[0015] As shown in Fig. 1 and Fig. 4, when the diaphragm drive mechanism 15 is disposed at the upper left portion viewed from the front side, by providing the diaphragm motor 31 at the upper side of the shutter drive mechanism 12a and providing a reduction gear row 39 in front of the shutter drive mechanism 12a, they are housed in a comparatively compact manner. Disposition of the diaphragm motor at the lower side of the shutter drive mechanism 12a is also advantageous for realizing

compactness. In the figures, the reference numeral 18 indicates a coupler withdrawing lever which has a rotation shaft at the upper side of the mirror frame 13, and this lever can be slightly pressed down forward and rearward by swinging it around this rotation shaft. This lever 18 can withdraw the lock pin 17 to a withdrawn position by being pressed down rearward.

[0016] As an electric contact for current supply or data exchange between the camera body 10 and the lens body 20, a camera side signal contact 19 is provided at the inner circumferential upper part of the camera mount plate 11.

[0017] Fig. 2 is a back view of the lens body 20 having the connection mechanism of this embodiment. The lens body 20 comprises a lens mount plate 21 corresponding to the camera mount plate 11. On the lens mount plate 21, lens side couplers 22 and 23 corresponding to the couplers 30 and 33 and a lens lock groove 27 adapted to the lock pin 17 are provided.

[0018] The diaphragm coupler 23 and the focus coupler 22 are arranged so as to be point-symmetric about the optical axis of the lens group, so that the connection mechanisms from the couplers 22 and 23 to the diaphragm drive mechanism 24 and the focus driving mechanism 37 ahead of the couplers 22 and 23 are prevented from crossing-over in the arrangement space, making it possible to secure respective individual spaces.

[0019] Furthermore, adjustments of the flange focus of the lens is generally realized by sandwiching back washers between the mount plate and the main body when attaching the mount plate and by changing the number of or thicknesses of the back washers. For the washers, C-shaped rings (notched at portions with couplers) that have almost the same diameter as the outer diameter of the mount plate and widths of several mm are used in a case where the number of couplers provided is one, however, when two couplers are provided at mount parts as in this invention, two notches corresponding to these couplers are necessary, so that two washers are paired. In this embodiment, since the two couplers 22 and 23 are point-symmetric about the optical axis, washers having the same shape can be used for the two washers, and preparation of washers with different shapes is not necessary.

[0020] Rotation of the diaphragm coupler 23 is transmitted to a diaphragm cam plate gear 25 of the diaphragm drive mechanism 24 through the outer circumferential side of the lens group, and in response to rotation of the cam plate, the diaphragm blades 28 are driven. This cam plate gear 25 is pressed toward an opening direction for play gathering by a spring that is not shown, and at one end, a limit switch 26 for detecting the opening end is provided. When the cam plate gear 25 is at the

opening end position, this limit switch 26 comes into contact with a switch contact piece extracted from the lens side signal contact 29 and is then turned on, and a signal indicating a diaphragm opened condition is transmitted to the camera body 10 side.

[0021] When the diaphragm blades 28 are driven from the camera body 10 side, since the limit switch 26 is turned off when the play of the driving force transmission system is eliminated and the diaphragm substantially starts moving from the opened condition, the stopping-down amount can be controlled based on this timing. Fig. 3 is a drawing showing the condition where the diaphragm is thus stopped-down by a predetermined amount viewed from the back surface side of the lens body 20.

[0022] In the camera mounted with the lens, due to engagement between the couplers 22 and 23 and the couplers 30 and 33 penetrating the joint surfaces of the mount plates 11 and 21, a driving force transmission system from the camera body 10 side to the diaphragm drive mechanism 24 and the focus drive mechanism 37 inside the lens body 20 is connected. Furthermore, when the lens body 20 is detached, as shown in Fig. 5, by slightly pressing the coupler withdrawing lever 18 down toward the inner side of the camera body 10, the couplers 30 and 33 and the lock pin 17 are withdrawn to positions more inward than

the joint surface of the camera mount plate 11, so that the lens body 20 can rotate around the optical axis of the image-taking optical system on the joint surface, whereby detaching of the lens body becomes possible. At this point of mounting or detaching, the rotation angle of the lens body 20 (90 degrees at maximum) is smaller than the center angle (180 degrees) between the two couplers 30 and 33, and therefore, even when the couplers 30 and 33 have the same shape, the diaphragm drive mechanism and the focus drive mechanism are prevented from being connected in reverse by mistake. This relationship is satisfied by setting the center angle between the two couplers to be larger than 90 degrees.

[0023] When the lens side couplers 22 and 23 are shaft-borne by the same member, if slight divergence exists in the positional relationship between the two bearings, the two couplers entangle and their operations may become nonsmooth. In this embodiment, the lens side diaphragm coupler 23 corresponding to the diaphragm coupler 30 positioned at the side of the smaller rotation radius of the coupler withdrawing lever 18 is shaft-borne by the mount plate 21, and the lens side focus coupler 22 corresponding to the focus coupler 33 positioned at the side of the larger rotation radius is shaft-borne by a fixed barrel (not shown) of the lens body 20

upon penetrating the mount plate 21. Thus, one coupler is shaft-borne by the mount plate and the other coupler is shaft-borne by a separate member, whereby the couplers can smoothly operate without entanglement, and also, when the mount plate 21 is screwed into the lens body 20 side to assemble, adjustments becomes possible.

[0024] Next, focus driving is described. In a complete preparation condition where image-taking is possible, a light flux that has passed through the lens system and the main mirror 14 (half mirror) is changed in direction by a sub mirror 36 and guided by a rangefinding sensor (not shown), and rangefinding is carried out. An appropriate focus driving amount and direction are calculated through calculation based on output data from this rangefinding sensor. Successively, power is supplied to the focus motor 34, and while the total number of revolutions and rotation speed of the motor 34 are fully monitored, driving by the calculated focus driving amount is carried out and then stopped. At this point, if a focused condition is not obtained yet, rangefinding and calculation are carried out again, and based on the results, output data and calculation results are fed back and focus driving is repeated until a focused condition is obtained. The total number of revolutions and rotation speed of the focus motor

34 are controlled by a focus motor encoder 35 provided in the reduction gear system of this motor. This encoder uses a sensor such as a photo-interrupter, etc.

[0025] The camera sequence (see Fig. 6) of image-taking of one frame by a camera having the connection mechanism of this embodiment is as follows. Herein, a case where the diaphragm motor 31 is a DC motor exclusively used for driving is described. A camera in an image-taking standby condition turns into an image-taking preparation operation when an operation switch S1 is turned on (#101). In a mode in which exposure and focus control are automatic, first, photometry (#102) and rangefinding (#103) are simultaneously carried out. Photometric data is processed by means of a predetermined exposure calculation algorithm, and as mentioned above, by supplying the focus motor 34 with power, the focus drive mechanism 37 of the lens body 20 side is driven via the focus couplers 22 and 33.

[0026] Next, when an operation switch S2 is turned on, the camera turns into an image-taking operation (#104). At the beginning of the image-taking operation, release operations (#105, 106, 107, 108, and 109) of mechanical parts of the mirrors 14 and 36, the shutter 12, and the diaphragm are simultaneously carried out. Regarding the shutter 12, first,

magnets for shutter blade running control are supplied with power and running pieces are electromagnetically adsorbed (#105), and then mechanical latching of the shutter blade running system is released by the release mechanism, and likewise the main mirror 14 and the sub mirror 36 are withdrawn to the outside of the image-taking optical path by the release mechanism (#106). The release operations of the shutter 12 and the mirrors 14 and 36 are carried out by separate actuators such as motors that are not shown.

[0027] The diaphragm stops the diaphragm drive mechanism 24 down at the lens body 20 side via the diaphragm couplers 23 and 30 to a predetermined f-number by forward driving of the diaphragm motor 31 (#107). When the diaphragm motor 31 is supplied with power, in response to the amount of forward rotation of the motor, encoder pulse signals are outputted from the diaphragm motor encoder 32 provided in the reduction gear system. When the diaphragm motor 31 slightly rotates, the play including backlash up to the cam plate gear 25 of the lens body 20 side is eliminated, and the diaphragm drive mechanism 24 substantially starts operating, the limit switch 26 is turned off. The stopping-down amount is in proportion to the total number of counts of pulses of the motor encoder 32 after the limit switch 26 is turned off (#108). Next, in order to stop

the drive mechanism at the target f-number, in this embodiment, brake control is realized by reversed power supply to the diaphragm motor 31 (#109). The amount of overrun by reversed powered braking applied at a predetermined rotation speed is estimated by several parameters (power supply voltage, inertia of the rotational mechanism, load torque, and motor characteristics, etc.), so that reversed powered braking is started at a point earlier than the target f-number in accordance with the estimated amount of overrun, and when the motor rotation speed becomes zero, reversed power supply is stopped.

[0028] When a series of release operations including latch releasing of the shutter running mechanism, withdrawal of the mirrors, and f-number setting are finished, the shutter 12 substantially runs and exposure to the film is carried out (#110).

[0029] When exposure is finished, return charging of the mechanisms operated in the release process and one-frame winding of the film are carried out. Returning of the mirrors 14 and 36 that are at the withdrawn positions, return charging to the initial position and latching onto the initial position of the run shutter 12 are carried out by separately provided charging motors that are not shown (#111). Along with this

operation, one-frame winding of the film is carried out by a film feeding motor (not shown) (#112). Furthermore, along with these operations, return to opening of the diaphragm is carried out by reverse-driving the diaphragm motor 31 (#113). When the diaphragm motor 31 is rotated in reverse, the limit switch 26 is turned on when the motor is driven to the opening position, so that turning-off of the power supply at this timing achieves return to opening. In this case, it is considered that mechanism collision occurs at the opening end, and in a case where this collision poses a problem, a torque limiter is provided in the diaphragm drive transmission system, or pulses of the diaphragm motor encoder 32 are monitored even during reverse-rotation, whereby such collision can be prevented.

[0030] That is the end of one-frame image-taking sequence, and then, the camera enters into the next image-taking standby condition.

[0031] Fig. 7 is a flowchart showing the sequence of a connecting operation of the diaphragm couplers in this embodiment. Regarding coupling of the diaphragm couplers 23 and 30 of this embodiment, as shown in Fig. 1 through Fig. 3, the camera side diaphragm coupler 30 has a convex key portion at its front end, the lens side coupler 23 has a concave key portion, and these are engageable with each other. However,

even in a condition where the lens body 20 is mounted on the camera body 10, if the phases of the couplers do not match, the driving force from the camera side is not transmitted to the lens side. The same applies to the case of the focus couplers. Therefore, discordance of the coupler phases must be avoided, and the couplers are connected according to the sequence flow shown in Fig. 7.

[0032] When the power supply of the camera is on, in a case where the lens is mounted or replaced (YES in #202), lens mounting or detachment can be distinguished by data exchange via signal contacts 19 and 29, so that lens mounting is detected thereby and coupler matching is carried out at this point. On the other hand, in a case where the lens is mounted or replaced when the power supply of the camera is off, the lens mounting or detachment cannot be monitored. Therefore, coupler matching is carried out each time the power switch S0 is turned on (YES in #201).

[0033] The diaphragm motor 31 is driven forward at the beginning and then rotated by a predetermined amount (#203), the camera side diaphragm coupler 30 is engaged with the lens side diaphragm coupler 23 by matching their phases, and thereafter, reverse driving is carried out (#204) and the diaphragm drive mechanism 24 of the lens body 20 side is returned to the open

condition, whereby driving for phase matching of the diaphragm couplers is carried out. In the case of this embodiment, the key engagement between the diaphragm couplers 23 and 30 are possible at two points per one rotation of the couplers, therefore, at least 1/2 rotation is necessary as the forward driving amount of the diaphragm motor 31.

[0034] Furthermore, by providing a switch for distinguishing the projecting and withdrawn conditions of the couplers at the coupler portion, unnecessary coupler matching operation can be reduced. In this case, the coupler matching operation is carried out in the "condition where the lens is mounted and the couplers are withdrawn," and forward driving in this case is carried out until the "coupler projecting condition" is detected.

[0035] As mentioned above, the diaphragm couplers 23 and 30 can be disposed at positions with the same radius distance from the optical axis as those of the focus couplers 22 and 32, making it unnecessary to increase the widths of the mount parts. Furthermore, since the center angle between the couplers is 180 degrees that is larger than the lens body maximum rotation angle of 90 degrees in the case where the number of mount claws is minimum (two), when the lens is mounted or detached, there is no instance where one coupler passes over the other coupler,

whereby erroneous connection does not occur. Moreover, common couplers can be used for both diaphragm couplers and the focus couplers.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1] A front view showing in perspective the main part mechanism of the camera body side having the connection mechanism of this embodiment.

[Fig. 2] A back view of the lens body having the connection mechanism of this embodiment.

[Fig. 3] A drawing showing the condition where the diaphragm is stopped-down by a predetermined amount viewed from the back surface side of the lens body.

[Fig. 4] A side view showing in perspective the diaphragm drive mechanism and the focus drive mechanism in a condition where the lens body is mounted on the camera body having the connection mechanism of this embodiment.

[Fig. 5] A side view showing the condition where the lens body is detached from the camera body in Fig. 4.

[Fig. 6] A flowchart showing the camera sequence of one-frame image-taking by the camera having the connection mechanism of this embodiment.

[Fig. 7] A flowchart showing the sequence of the diaphragm coupler connecting operation in this embodiment.

[Description of Symbols]

10 camera body

11 camera mount plate

12 focal plane shutter

12a shutter drive mechanism

13 mirror frame

14 main mirror

15 diaphragm drive mechanism

16 focus drive mechanism

17 lock pin

18 coupler withdrawing lever

19 camera side signal contact

20 lens body

21 lens mount plate

22 focus coupler

23 diaphragm coupler

24 diaphragm drive mechanism

25 cam plate gear

26 limit switch

27 lens lock groove

28 diaphragm blade

29 lens side signal contact

30 diaphragm coupler

31 diaphragm motor

32 diaphragm motor encoder

33 focus coupler

34 focus motor

35 focus motor encoder

36 sub mirror

37 focus drive mechanism

38 focusing lens

39 reduction gear row

Fig.1

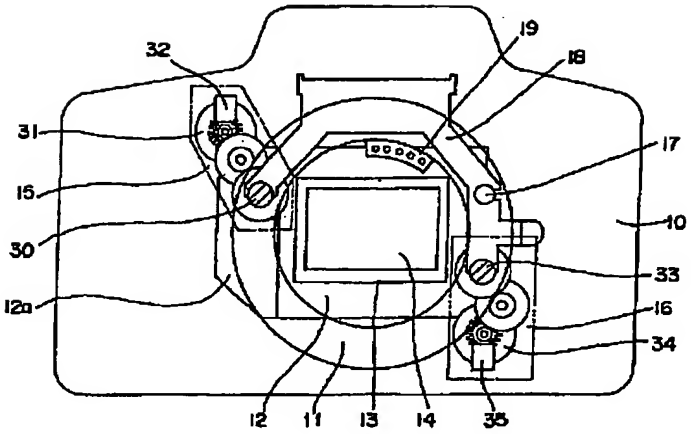

Fig.2

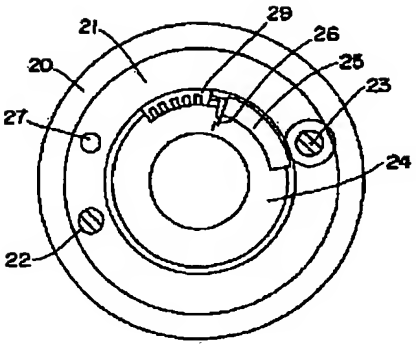

Fig.3

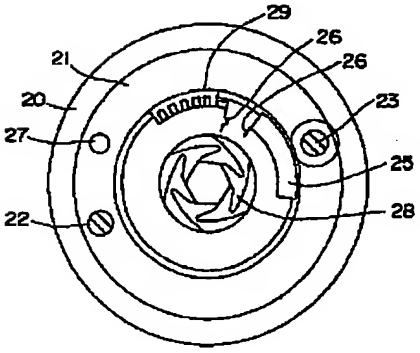

Fig.4

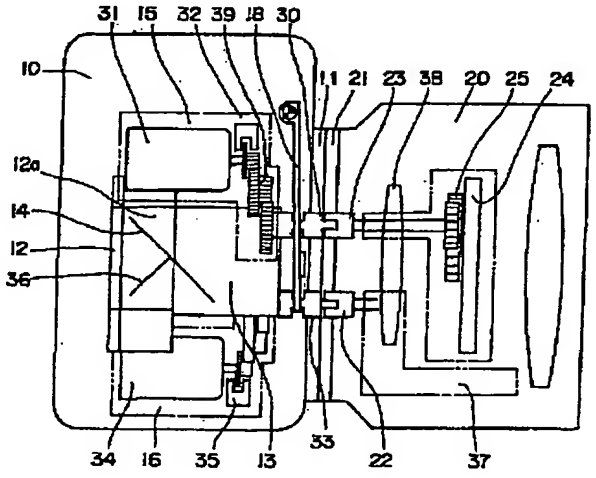

Fig.5

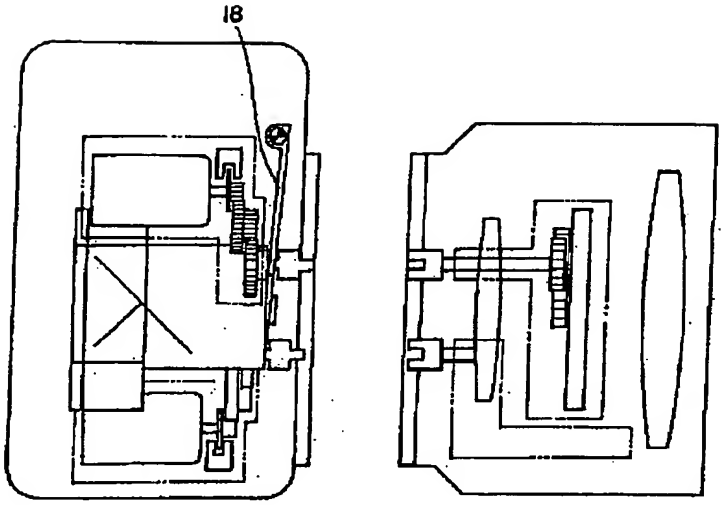

Fig.6

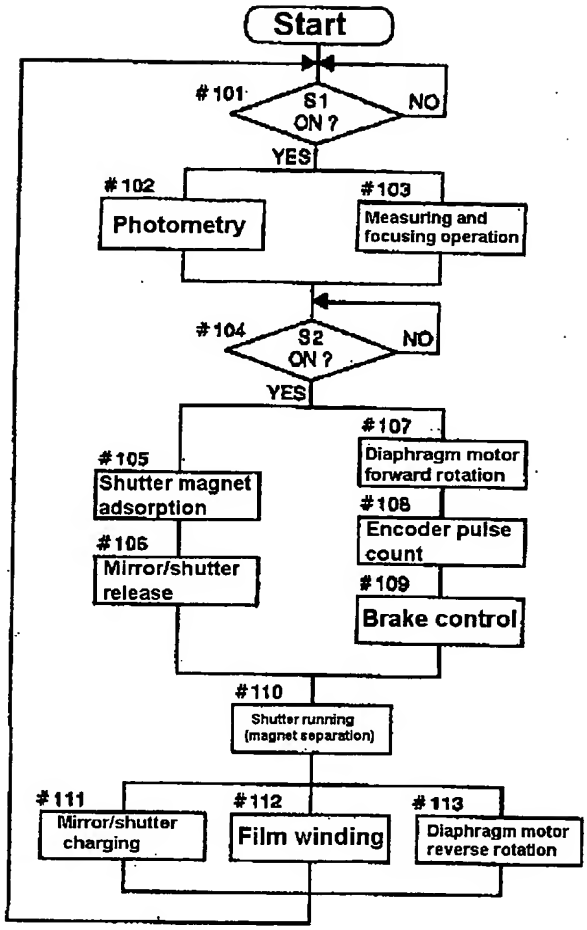

Fig.7